The use of the new MATLAB Financial Kit for development of economical and financial models

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Abstract

The growing interest of physical and mathematical researchers to new areas as:

market modeling and prediction,
risk management and option pricing,
agent-based modeling,
time series empirical analysis,

is due mainly by the stochastic nature of most of the financial processes. Constraining by this interest it become actual to develop a comprehensive software environment, which in the frame of a common concept will use the same models, without the need of simplification for quantitative analysis. The main advantage for such approach is that it provides to the end-users (including also students) of rapid prototyping, high-quality visualization , and enhanced model testing.

The purpose of this work is to demonstrate the usefulness and flexibility of the new MATLAB Financial Kit for development of the Option Pricing Tool. This Tool allows presentation of the obtained results in any convenient (for the user) form. It can start from loading the data (Database toolbox), Datafeed toolbox , EXEL link), via the Financial toolbox (for quantitative modeling and analytical prototyping) up to the results presentation (MATLAB Report Generator, MATLAB Runtime Server). This allows to take the existing MATLAB application and turn it into a stand-alone product.

Introduction

The dynamic behavior of the economical processes, and the stochastic changes of the financial markets, require the use of new approaches for the academic training of the economical and finance engineering experts. This approach has to work out a common concept, which will bring the process of teaching of the future financial professionalists to the a real process of financial application development. This will include:

a) development of theoretical models in the areas of fixed income, derivatives ,risk management, foreign exchange modeling - the subjects of academic research,

b) implementation and modification of existing theoretical models and creating prototype, analytic – the subjects of quantitative research,

c) use of aggregation of these analytic's to create applications, which are deployed for initial testing by end-user – the subject for development.

The aim of our work is to choose one single united software environment, which together with modern technology achievements may be used as:

- teaching tool, for learning many financial subjects,
- development tool, for each (a-c) stages of financial application development process, as described above.

Choice of software environment

According to this aim, we will analyze those software packages, which today are widely used not only for teaching purposes, but also for academic and quantitative researches.

These are: MATLAB 6.0, Mathematica 4.1, Maple 7, GPE2.

The selected optimal software must fulfill to following requirements:

- ease-to-use, ease-to-learn,
- built-in functionality and capabilities,

- deployment,
- connectivity.

First of all from the above-mentioned software list we need to exclude GPE2, because it does not fulfill the main requirement the “ease-to-learn”. GPE2 is an econometric package, running under GAUSS programming environment, which not an easy language to learn and master [1]. The comparative analysis of remained software packages is continued in the Table.

Table **Comparison between software packages**

	Potential use in Finance	MATLAB 6.0	**Mathematica 4.1**	**Maple 7**
Built-in capabilities and functionality	Fixed income pricing, yield and sensitivity analysis. Advanced term structure, modeling & analysis	Financial Toolbox	Finance Essentials	Finance Package
	Create and manage portfolios containing several types of financial instruments	Financial Derivatives Toolbox	Derivatives Expert 2	Finance package (partly)
	Data transformation and analysis of functionality	Financial Time series Toolbox	Data time Series package	--
	Monte-Carlo simulation. Volatility forecasting of GRACH process	GRACH Toolbox	--	--
	Risk management.	Finance Toolbox	UnRisk Package	--
	Reporting	Matlab Report Generator	--	--
Deployment	Desktop deployment	RunTime Server	--	--
	WEB deployment	Matlab WEB Server	Mathematica WEB server	WEB Connectivity with TCP/IP
Connectivity	Direct access to all built-in Excel spreadsheets	Excel Link	The Mathematica Excel Link	Link to Microsoft Excel 2000
	Database connectivity Financial database connectivity	Database Toolbox Toolbox Datafeed	Database Package --	-- Sockets pack

Analysis of the data shown in the Table allows making an argumentated selection for a universal software - the Financial Kit of MATLAB 6,which provide the more:

built-in functionality ,due to the presence of the GRACH Toolbox and of the MATLAB Report Generator Toolbox,

deployment possibilities, due to the presence of the Desktop deployment (Runtime Server),

connectivity possibilities, due to the ability of loading special financial data using the DataFeed Toolbox.

Additional to these advantages only the MATLAB has its own Graphical User Interface Tool (GUI). The presence of the GUI allows of effective use of the MATLAB 6.0 Financial Kit for teaching purposes. Therefore we recommend changing of the existing teaching methodology of several courses , using the advantages of this package.

Learning of the pricing theory use of the "Option Pricing Tool"

The Option pricing theory is one of the obligatory courses for students graduating in economics and finance. Let us consider the changes, which have to be introduced by the lecturer. First of all the theoretical part of the course, based on the Block-Schols theorem for European Call &Put options and Binomial for the American options sensitivities, that means six basic sensitivity measures associated with option pricing can be presented traditionally [2]. These are: delta, gamma, lambda, rho, theta and vega (all Greeks) and other measures, which are useful for managing portfolios and for executing collars, hedges and straddles..At the same time every theoretical message can be illustrated with the special GUI "Option Pricing Tool [3], permitting the students to take part in the interactive dialog. In Fig.1 we are presenting an example of GUI for the Binomial Tree model of the European Call Option.

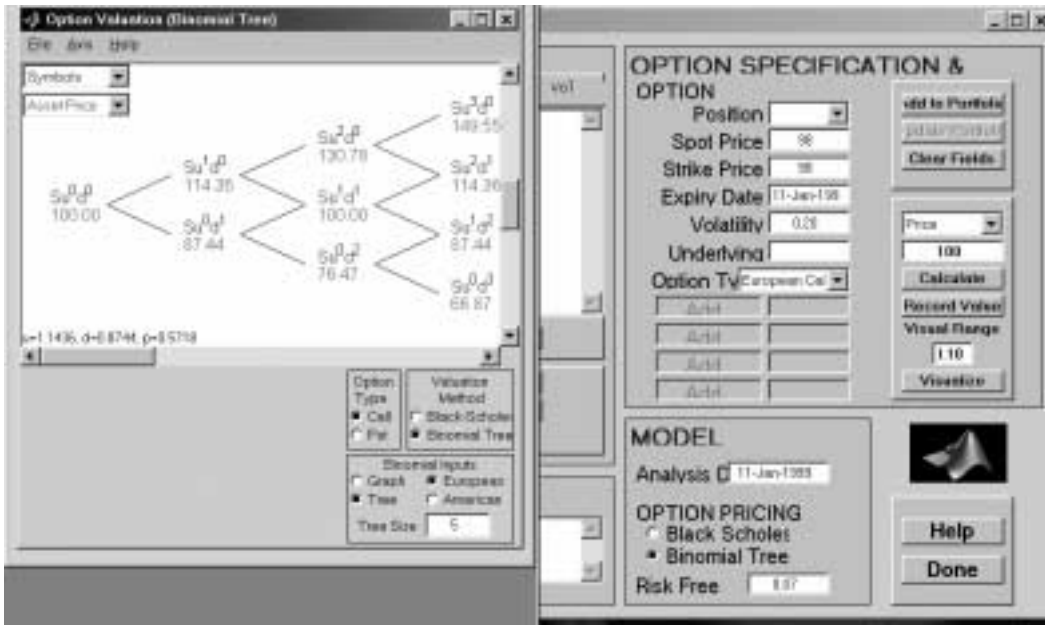

Fig.1. The main "Option pricing window" with Binomial Tree graphical output window

Let us consider how to use the same GUI for the development of another type of options.

It is well-known, that European and American puts and calls are the most popular type of financial options. However, the expansion of new financial markets, caused the spawning of many other type of options, for example, the "exotic" options. As it was proposed in [4] the early exercise of the option's value is equal to the maximum of a price of the option, exercised immediately. Thus, we have a standard American option pricing problem.

For checking the difference between two call options we are presenting the following example: An initial stock price –100$, time until maturity - one-half year, sigma- 0.35, risk free – 0.08. First of all we have to change some of the parameters in the main "Option Pricing Tool" window (Fig.1). Thus, in the "**Option type**" field , choose AmerAvrCall, than press the "**Add**" button and write in the its opposite blank field **Option1** .The same procedure has to be done for the second option. After pressing on "**Calculate**" button ,we will obtain in the MATLAB command window the desired quantitative result.

After pressing the **Visualize** button the user gets a graphical window (Fig.2), that presents the difference between AmerAvgCall and EurAvgCall. Analysis of this curve allows to conclude, that the American Average Call is more valuable, than the European Average Call, that the American Average Call is more valuable, than the European Average Call, for the "exotic"options – options whose price depends on the whole price path of the underlying asset.

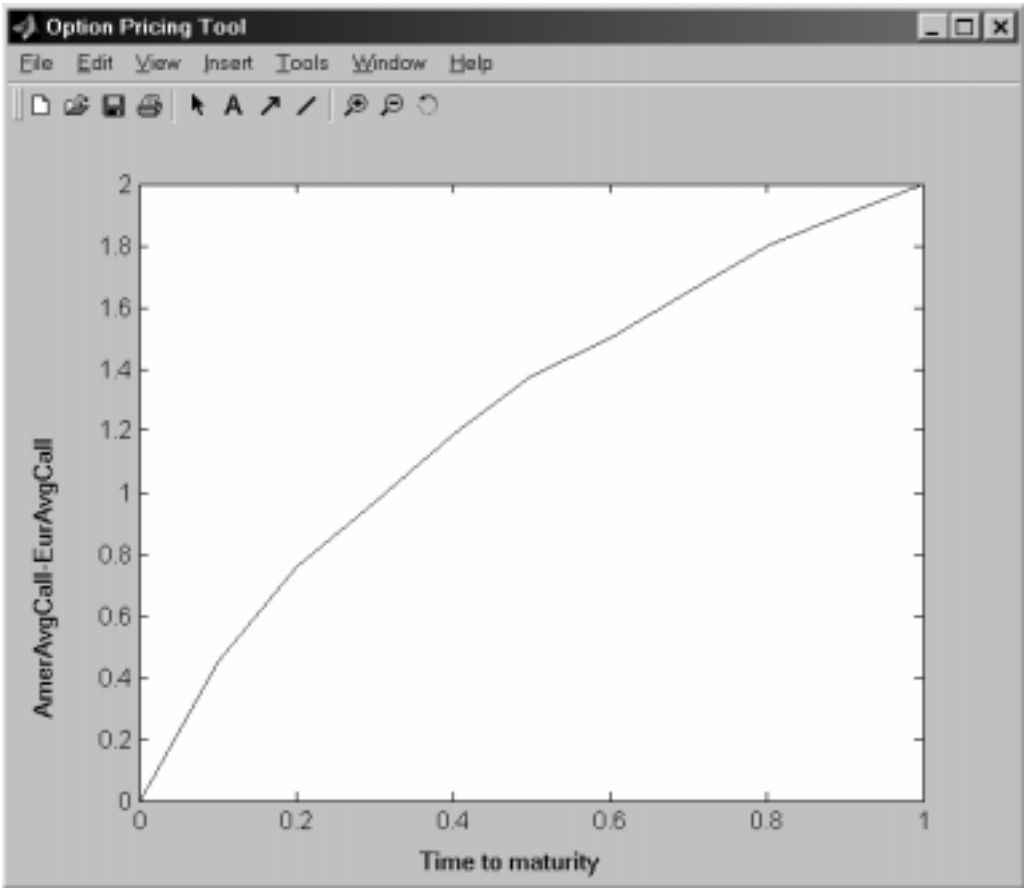

Fig.2. The difference between AmerAvgCall and EurAvgCall.

Conclusion

As a teaching environment MATLAB 6 Financial Kit focuses the students on the theory and application ,rather than on programming details. It is ideal for instructing concepts, illustrating examples and challenging students with analytical homework problems that need to be solved. MATLAB helps students for a better understanding of the material and applying of leading-edge concepts in economic and finance.

Students can master the latest techniques for fixed income, derivatives, option pricing, forecasting, emerging markets, portfolio optimization, neural networks, and financial application development, preparing them for the career in the economics and finance disciplines.

As a development environment MATLAB 6 Financial Kit provides an outstanding set of features and functions that enable software developers for rapidly growing**,** test and tune applications. Developers can create their own algorithms or modify existing MATLAB functions to perform the required tasks and significantly reduce their development time. The flexibility of MATLAB can be used for quick (rapid) deployment of the complex software to the end –user.

References

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